

Rediscovery of Ooline, *Cadellia pentastylis*, near Gunnedah: notes on the habitat and ecology of this dry rainforest tree

Timothy J. Curran¹ and Sandra R. Curran²

¹Botany, Centre for Ecology, Evolution and Systematics, University of New England, Armidale NSW 2351, AUSTRALIA
tcurran2@une.edu.au ph: 02 6773 2324; fax: 02 6773 3283

²St Mary's College, Gunnedah NSW 2380, AUSTRALIA

Abstract: *Cadellia pentastylis* F.Muell., (family Surianaceae), a dry rainforest tree with a conservation listing of Vulnerable at state and national levels, was first collected from the Gunnedah area by the botanical collector J.L. Boorman in 1907. We report the first record of *Cadellia pentastylis* from the Gunnedah area (30°58'49"S, 150°15'15"E) since 1907, and provide details of the community and habitat where it occurs, on the lower slopes of Black Jack Mountain. Although this population is one of the smallest in New South Wales, it is significant as it is at its southern distributional limit, and is found adjacent to semi-evergreen vine thicket, another type of dry rainforest, on the same hillslope. We list the New South Wales occurrences of this species and discuss aspects of its flowering phenology.

Cunninghamia (2005) 9(2): 311–316

Introduction

Botanical exploration is replete with tales of rediscovery of species or populations thought to be lost from an area; e.g. the rediscovery of the cool-temperate rainforest species *Nothofagus moorei* on the Comboyne Plateau (Bale & Williams 1994) or the suspected demise and subsequent rediscovery of *Hakea pulvinifera*, an extremely rare species known only from a single hillside near Lake Keepit east of Gunnedah (Leigh et al. 1984; Barker & Morrison 1989). In 1994, Bob Howarth of Gunnedah brought samples of a 'red-flowered' tree collected on Black Jack Mountain, south-west of Gunnedah to one of us (SRC). At the time, the samples could not be identified, but several years later SRC recognized the line drawing on the cover of Benson's (1993) Ooline Species Management Plan as resembling Howarth's specimen. No reference could be found to *Cadellia pentastylis* F.Muell. having red petals or sepals (Beadle 1984 cited in Benson 1993; Harden 1991) and the matter was taken no further.

In November 2004, *Cadellia pentastylis* flowered extensively in the Narrabri district (James Faris & Geoff Robertson, pers. comm.). Specimens and photographs of the early stages of fruit development showed that the petals had fallen with the light brown to red coloured sepals persisting. When shown specimens in fruit, Bob Howarth confirmed that they were similar to those that he had seen in 1994, and showed TJC the locality of the plants now confirmed as *Cadellia pentastylis*.

This was not the first record of *Cadellia pentastylis* from the Gunnedah area. In 1907, the botanical collector John Lucas Boorman lodged a sterile specimen at the National Herbarium of NSW (NSW 362008) but there are few details

to accompany this specimen and the locality referred simply to "Gunnedah" (Peter Hind pers. comm. 2005). The species has not been recorded in the locality since but given the scant location details provided by Boorman, it is not possible to determine if the population he collected from is the same one reported here.

Cadellia pentastylis is a medium to large tree, known colloquially as 'Ooline' or 'Scrub Myrtle' (Benson 1993). It is the only member of its genus (Harden 2002) and is placed in a family, Surianaceae, which has only four genera (of which three are monotypic) and five species (Ian Telford pers. comm.). *Cadellia pentastylis* is of rainforest origin (Benson 1993) and its putative closest living relative, *Guilfoylia monostylis*, is a shrub or small tree found in several rainforest types on the east coast of Australia.

Cadellia pentastylis is endemic to the North Western Slopes of NSW and southern and central Queensland south from near Emerald (Gwen Harden pers. comm.). Since European settlement, much of the natural habitat of *Cadellia pentastylis* has been cleared for cropping or grazing (Benson 1993). It is now listed as a Vulnerable species under the NSW *Threatened Species Conservation (TSC) Act 1995* and under the Commonwealth *Environment Protection and Biodiversity Act 1999*. Furthermore, the *Cadellia pentastylis* community is listed as an Endangered Ecological Community in NSW under the TSC Act.

In this paper we describe the vegetation and habitat of the *Cadellia pentastylis* population on Black Jack Mountain, and relate the timing of flowering to rainfall records from Gunnedah.

Methods

Survey work on Black Jack Mountain was conducted in December 2004 and January 2005 to describe the environment and vegetation associated with *Cadellia pentastylis*. The boundaries of the *Cadellia pentastylis* population were recorded with a global positioning system. A species list was compiled from foot traverses through the two stands and from data collected for a 20 m x 20 m floristic plot undertaken as part of a larger survey of dry rainforest. The density of *Cadellia pentastylis* was estimated by recording the number of individuals from three different size classes (large tree - diameter at breast height (DBH) > 10 cm; small tree - DBH < 10 cm; seedling < 50 cm height) in each of four 20 m x 20 m plots in the eastern stand which were located to sample the range of densities. Benson (1993) noted the ability of *Cadellia pentastylis* to coppice, and this presents problems in estimating the number of individuals. For our density counts we recorded any separate stem that was not obviously attached to another stem as a separate individual. Specimens of *Cadellia pentastylis* were collected (TJ Curran 201) and have been lodged in the NCW Beadle Herbarium (NE), the Australian National Herbarium (CANB), the National Herbarium of NSW (NSW) and the Queensland Herbarium (BRI).

To look for any additional stands of *Cadellia pentastylis* on nearby hills to the north and south of the Black Jack Mountain population we used binoculars to survey from public roads.

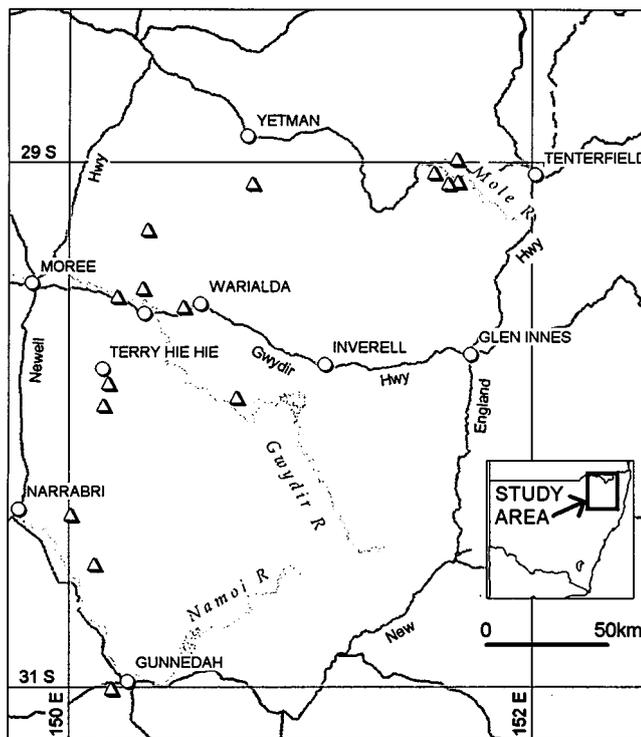


Fig. 1. Location of populations of *Cadellia pentastylis* in NSW. Each population from Table 1 is denoted by a triangle.

Monthly rainfall records for the Gunnedah area for 2004 (Namoi Valley Independent 2005) were compared with long term means from the Bureau of Meteorology (2005) to examine rainfall patterns in the months preceding the flowering and fruiting of *Cadellia pentastylis*.

Results and discussion

Habitat, ecology and statewide distribution

The Black Jack Mountain population of *Cadellia pentastylis* is on the upper slopes of a low hill (31°0'36"S, 150°11'21"E) approximately 7.5 km WSW of Gunnedah, upslope from the former coal washery at Black Jack Colliery, to the north of Black Jack Mountain. There were two separate stands approximately 100 m apart: one on a north-west facing slope; the other on a north and north-east facing slope. The stands typically occur on skeletal sandy loam soils, on generally steep slopes (18–30°) at altitudes of 430–480 m.

The geology of the hillslope is complex, being a mix of igneous rocks, sediments and metamorphosed sediments. The habitat occupied by *Cadellia pentastylis* is predominantly conglomerate, either of the Black Jack Formation of Upper Permian age or Digby Conglomerate of Triassic age (NSW Dept. of Mines 1971a; Dept. of Mineral Resources 1996). Black Jack Mountain, upslope to the south, is capped by igneous rocks interpreted as Tertiary basalt (NSW Dept. of Mines 1971a) or as Glenrowan Intrusives (Late Jurassic sills and dykes) (NSW Dept. of Mineral Resources 1996). Known as the Black Jack Sill, this volcanic cap is listed on the Register of the National Estate as a geological reference site for igneous intrusions (Australian Heritage Commission 1993).

In both stands *Cadellia pentastylis* is the dominant species, with occasional *Geijera parviflora* or *Callitris glaucophylla*, or on the western edge of the western stand, *Eucalyptus albens*, in the canopy. Other small tree species associated with the two *Cadellia pentastylis* stands included *Ehretia membranifolia*, *Notelaea microcarpa* var. *microcarpa*, *Alphitonia excelsa*, *Eremophila mitchellii*, *Capparis mitchellii* and *Alectryon oleifolius* subsp. *elongatus*. Shrubs present included *Croton phebaloides*, *Rhagodia parabolica*, *Beyeria viscosa*, *Acacia decora*, *Maytenus cunninghamii*, *Canthium odoratum*, *Solanum parviflora*, *Abutilon tubulosum*, *Abutilon oxycarpum* and *Olearia* sp. aff. *elliptica*. Vines such as *Parsonia lanceolata*, *Pandorea pandorana* and *Marsdenia viridiflora* were abundant in places and *Parsonia eucalyptophylla* was also present. The ground cover, which was sparse in places where there was a dense canopy of *Cadellia pentastylis* and other species, comprised grasses such as *Aristida gracilipes*, *Digitaria brownii* and *Cymbopogon refractus*, herbs such as *Malvastrum americanum*, *Einadia nutans* subsp. *linifolia*, and *Einadia hastata*, and the fern *Cheilanthes distans*. Of particular interest was the abundance of the epiphytic orchid, *Cymbidium canaliculatum*, which occurred in high densities on *Cadellia pentastylis*.

The vegetation upslope and to the west of the *Cadellia pentastylis* community was *Eucalyptus albens* shrubby woodland; downslope and to the south of the *Cadellia pentastylis* was semi-evergreen vine thicket (SEVT) dominated by *Ehretia membranifolia*, *Geijera parviflora* and *Notelaea microcarpa* var. *microcarpa*. Many species common to both the SEVT and *Eucalyptus albens* woodland were found in the *Cadellia pentastylis* community.

It is likely that there are more stands of *Cadellia pentastylis* on north-east facing slopes on a low ridge to the north of Black Jack Mountain. This ridge has similar geology to the low ridge we sampled and though we did not visit this area on foot, inspection with binoculars from Black Jack Road showed trees of the same colour and texture as *Cadellia pentastylis*. If this ridge does support *Cadellia pentastylis* it is likely that these stands are considerably larger than the ones reported in this paper. It is also possible that there are smaller stands on the eastern slopes of Black Jack Mountain further south.

While *Cadellia pentastylis* has an extensive, though threatened, distribution in southern Queensland, it is known from only a few locations in NSW (Benson 1993; Geoff Robertson pers. comm.; Table 1; Fig. 1). The population at Black Jack Mountain, Gunnedah is the southern-most known population. To the north the nearest known population is at Turkey Ridge, near Maules Creek approximately 60 km away (Benson 1993). Though the Black Jack Mountain population appears to be one of the smallest in NSW, it is of high conservation significance as it is at the southern distributional limit of the species.

A feature of the Black Jack Mountain population is its proximity to the SEVT community. These two endangered communities share many species (Benson et al. 1996; Keith 2004). Indeed, Keith (2004) included both communities in the Western Vine Thickets vegetation class in his recent statewide overview, though in Queensland *Cadellia pentastylis* communities are treated as a sub-form of SEVT (McDonald 1996; Sattler & Williams 1999).

Table 1. Location, spatial extent, estimated size and geology of *Cadellia pentastylis* populations in NSW. Sources: ¹ Benson (1993); ² DEC (unpubl.); ³ Lachlan Copeland pers. comm.; ⁴ Hunter (2002); ⁵ Julian Wall pers. comm.; ⁶ Forestry Commission of NSW (1989); ⁷ NSW Dept. of Mines (1971b); ⁸ this paper. Where all information for a population is from the one source, that source is given with the location, otherwise the source is given for each datum. Populations are arranged in north to south order.

Location	Estimated area (ha)	Estimated population size	Geology
Tenterfield Creek Gorge, W of Tenterfield	100 ¹ –200 ⁺ 2	35 000 ¹	Claystone ¹
“Taronga”, Mole River	8 ² –10 ¹	3900 ¹	Claystone ¹
Rock of Gibraltar, W of Tenterfield	21 ²	1000 + ³	Acid volcanics ³ , likely Gibraltar Ignimbrite–ignimbrite rhyolite ⁴
Gibraltar Nature Reserve, W of Tenterfield	< 1 ⁵	< 100 ⁵	Sediments ⁵ , likely Bodonga Beds–Early Permian conglomerate, sandstone or minor siltstone ⁴
Bunal Flora Reserve, Bunal State Forest, NW of Ashford ⁶	Unavailable	Unavailable	Jurassic Warialda Sandstones
Crooble	Unavailable – remnant trees ²	30 ²	Unavailable, possibly Tertiary gravels, sands or clays ⁷
Gravesend	75 ¹ –100 ²	21 000 ¹	Sandstone–Claystone ¹
Biniguy	Unavailable ²	Unavailable ²	Unavailable, possibly Tertiary gravels, sands or clays ⁷
“Tara”, Warialda	10 ² –12 ¹	2700 ¹	Quartz Sandstone ¹
Gamilaraay Nature Reserve and surrounds, Terry Hie Hie ¹	113 (in reserve) + 262 (private land)	122 000	Recrystallised Quartzite - Sandstone
Mehi Flora Reserve, Mehi State Forest, E of Bingara ⁶	Unavailable	Unavailable	Ordovician sediments
Campbell State Forest, Terry Hie Hie	Few plants ²	Few plants ²	Unavailable, possibly Jurassic Warialda Sandstone or Rocky Creek Conglomerate ⁷
Deriah State Forest and nearby areas (e.g. Eulah Creek), Narrabri	186 ¹ –240 ²	54 000 ¹	Alluvium / Lithic Sandstone / Claystone ¹
Turkey Ridge, Maules Creek	350 ² –400 ¹	74 000 ¹	Wean Formation Conglomerate ¹
Black Jack Mt, Gunnedah ⁸	2	1000	Conglomerate (Digby or Black Jack Formation)

Benson et al. (1996) observed that in NSW SEVT and *Cadellia pentastylis* communities do not mix. In recent extensive sampling of dry rainforest vegetation (including SEVT and *Cadellia pentastylis* communities) on the western slopes of NSW (Curran in prep.), *Cadellia pentastylis* was not encountered growing with SEVT, though some stands, e.g. parts of the Deriah State Forest and Warialda populations, are very similar to SEVT in species composition. On Black Jack Mountain, there were extensive stands of SEVT, including patches immediately downslope and across-slope (to the south) from the *Cadellia pentastylis*. The igneous (basalt or dolerite) influence on parts of the hill, coupled with the likely deeper soils further downslope, could explain the presence of SEVT in such close proximity to *Cadellia pentastylis*. Benson (1993) noted a strong correlation between *Cadellia pentastylis* and either lithic sandstone or conglomerate substrates (see Table 1), and observed that southern stands tend to have northerly aspects. These patterns are consistent with the Black Jack Mountain population, which occurs on northerly aspects on conglomerate. This represents a likely stressful habitat, being both low in nutrients and low in moisture availability (likely on sandy loam or sandy clay and often skeletal soils with northerly aspect exposed to desiccating winds). In contrast, SEVT is mostly associated with higher nutrient, basalt-derived soils (Benson et al. 1996), though it does occur on conglomerates of the Black Jack Formation south of Curlewis (Curran in prep.). The vegetation of Black Jack Mountain may provide a natural laboratory to further explore the causal factors underpinning the distinction between SEVT and *Cadellia pentastylis* communities.

The Black Jack Mountain population of *Cadellia pentastylis* is largely unaffected by two of the major threats to the species - land-clearing and livestock over-grazing (Benson 1993). Though located on private land near a former coal mine, there is no immediate threat of land-clearing as the mine has closed down and the mine site is being restored. This presents an opportunity to plant additional *Cadellia pentastylis* nearby, though there is no evidence to suggest that the population has been reduced in extent by past clearing. However, there are some stumps of unidentified trees downslope of the population. The area is not currently grazed by livestock. A potential threat to the population is the lack of recruitment;



Fig. 2. Dense stand of *Cadellia pentastylis* at Black Jack Mountain, Gunnedah showing thick leaf litter and sparse ground cover. Plot 4 was located in this stand.

further research is needed to assess the implications of this. While *Cadellia pentastylis* may be vulnerable to fire (Benson 1993), there is nothing to suggest there is a high fire threat at Black Jack Mountain, and the limited access to the site (via private road) helps prevent arson.

Population size

The two stands of *Cadellia pentastylis* occupy approximately 2 ha — western stand 0.9 ha, eastern stand 1.0 ha. Sampling in the eastern stand showed a range of densities (Table 2); from 175 plants per ha in the sparsely populated Plot 3, to 1125 per ha in a plot with particularly dense *Cadellia pentastylis* (Plot 4; Fig. 2). The average density was 531 ± 206 per hectare, giving a total estimate of 1009 ± 392 plants for the two stands on Black Jack Mountain.

Flowering and fruiting and timing in relation to rainfall

Bob Howarth collected the flowering specimen of *Cadellia pentastylis* in 1994 in the middle of a severe drought in the Gunnedah area. Drawing on anecdotal information from landholders near other *Cadellia pentastylis* stands in NSW, Benson (1993) suggested that the species appeared to flower sporadically, with the last (i.e. pre 1988) previous profuse flowering reported from October 1986, which was

Table 2. Number of individuals of *Cadellia pentastylis* of different size classes in each of four 20 m x 20 m plots and mean stems per ha in the eastern stand on Black Jack Mountain, Gunnedah

Size class	Stems / 0.04 ha				Mean stems /ha (\pm s.e.)
	Plot 1	Plot 2	Plot 3	Plot 4	
Large tree (> 10 cm DBH)	14	9	7	15	281 (\pm 48)
Small tree (< 10 cm DBH)	4	6	0	30	250 (\pm 169)
Seedling (< 50 cm height)	0	0	0	0	0
Total plants	18	15	7	45	531 (\pm 206)

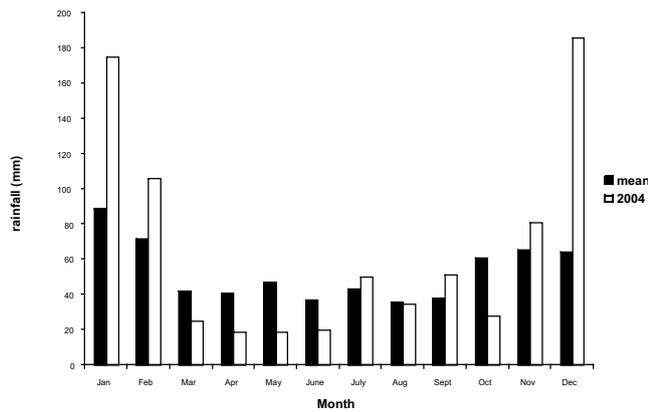


Fig. 3a. Monthly rainfall for Gunnedah for 2004 (Namoi Valley Independent 2005) and long term monthly mean rainfall for Gunnedah Soil Conservation Station (Bureau of Meteorology 2005). The most extensive recent flowering of *Cadellia pentastylis* was in November 2004.

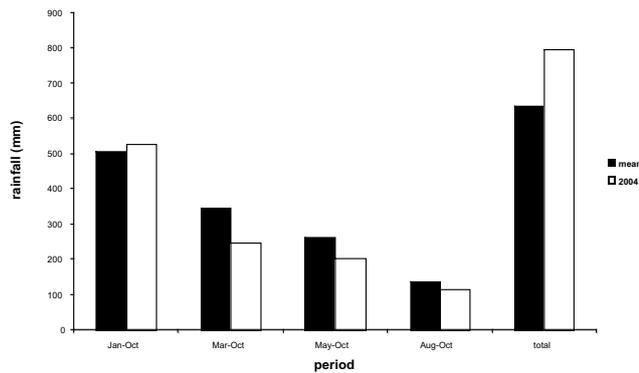


Fig. 3b. Comparison of rainfall at Gunnedah for 2004 against long term means for three month (Aug-Oct), six month (May-Oct), eight months (Mar-Oct) and 10 months (Jan-Oct) prior to 31st October 2004, and the flowering of *Cadellia pentastylis* in November 2004. Data sources as per Fig. 3a.

a dry year on the North Western Slopes. More recently, the species was noted fruiting extensively in December 2002 at Rock of Gibraltar, west of Tenterfield (Lachlan Copeland, pers. comm.), at the height of a very severe drought in NSW (Bureau of Meteorology 2003).

In 2004 Gunnedah recorded above average rainfall of 795 mm (Namoi Valley Independent 2005) against a long term average of 636 mm (Bureau of Meteorology 2005). This was mainly due to large falls in January (175 mm), February (106 mm) and December (186 mm) (Fig. 3a). In the Narrabri and Gunnedah areas the most recent extensive flowering of *Cadellia pentastylis* was in November 2004. Despite the above average rainfall at Gunnedah in 2004, the months preceding the likely onset of flowering were characterized by drier conditions - rainfall was below average for the three, six and eight month periods to 31st October 2004 (Fig. 3b). This

suggests that this recent flowering of *Cadellia pentastylis* might also have been triggered by dry conditions.

There was prolific fruiting in the *Cadellia pentastylis* population prior to and during sampling; and large amounts of seed were lying on the ground. Some was collected for germination trials.

No seedlings were recorded in any of the plots, though there were four probable seedlings on the south-eastern edge of the population. However, because these were close to an adult stem (i.e. within 5 m) it is possible that they were simply young coppicing stems from the adult plant. Benson (1993) noted that seedlings were rarely observed and were not present at some sites. However, as in other populations in NSW (Benson 1993), there were frequent examples of coppicing in the Black Jack Mountain population.

Acknowledgements

We wish to thank Bob Howarth for drawing our attention to the population at Gunnedah and for showing us the location. Penny Gardiner and Terry Curran assisted with field work or logistics and are thanked for their general support. Chris Burgess, Site Manager, Black Jack Colliery, gave us permission to access the stands described in this paper. Ian Telford, Geoff Robertson, James Faris, Sue Cox, Lachlan Copeland, Paul Sheringham, Peter Hind, Travis Peake, Stephen Bell, Bill McDonald, Julian Wall, Joanne Lello, Don Butler, Peter Clarke, John Williams and Jeremy Bruhl are gratefully thanked for information concerning *Cadellia pentastylis* and/or comments on the draft manuscript. Comments from Doug Benson and anonymous reviewers improved the text. Dave Mitchell kindly prepared the map of *Cadellia pentastylis* populations.

Finally, we wish to dedicate this paper to the late John B. Williams, Fellow of the University of New England, who recently passed away. John taught Botany to SRC and had many discussions with TJC on ooline and dry rainforest vegetation. His sharp insights, gentle nature and companionship will be sorely missed.

References

- Australian Heritage Commission (1993) Black Jack Sill. Unpublished advice. Australian Heritage Commission, Canberra.
- Bale, C.L. & Williams, J.B. (1994) Lost and found: *Nothofagus moorei* at Comboyne. *Cunninghamia* 3: 529–533.
- Barker, W.R. & Morrison, S.P. (1989) *Hakea pulvinifera* L. Johnson (Proteaceae): A rediscovered species under threat. *Journal of the Adelaide Botanic Gardens* 11: 175–177.
- Beadle, N.C.W. (1984) Simaroubaceae. In: *Students Flora of North-eastern New South Wales*, Part IV. (University of New England, Armidale).

- Benson, J.S. (1993) *The biology and management of Ooline (Cadellia pentastylis) in New South Wales*. Species Management Report No. 2. (NSW National Parks and Wildlife Service: Hurstville).
- Benson, J.S., Dick, R. & Zubovic, A. (1996) Semi-evergreen vine thicket vegetation at Derra Derra Ridge, Bingara, New South Wales. *Cunninghamia* 4: 497–510.
- Bureau of Meteorology (2003) Drought statement — Issued 4th February 2003 (Statement on Drought for the 10 and 14 month periods ending 31st January 2003). URL www.bom.gov.au/announcements/media_releases/climate/drought/20030204.shtml
- Bureau of Meteorology (2005) Climate averages for Australian Sites- Gunnedah SCS. URL www.bom.gov.au/climate/averages/tables/cw_055024.shtml
- Curran, (T.J.) Phytogeography and evolutionary ecology of dry rainforests on the western slopes of New South Wales. Unpub. PhD Thesis. (University of New England, Armidale).
- Department of Environment and Conservation (unpubl). Unpublished information on *Cadellia pentastylis*. Department of Environment and Conservation (NSW), Dubbo.
- Forestry Commission of New South Wales (1989). *Forest Preservation in State Forests of New South Wales*. 2nd Edition. (Forestry Commission of New South Wales: Sydney).
- Harden, G. J. (1991) Surianaceae. In *Flora of New South Wales*, Vol. 2. (ed. G.J. Harden). (NSW University Press: Kensington).
- Harden, G. J. (2002) Surianaceae. In *Flora of New South Wales*, Vol. 2. Revised Edition (ed. G.J. Harden). (University of NSW Press: Sydney).
- Hunter, J.T. (2002) Vegetation and floristics of the Tenterfield Nature Reserves (Bluff River, Bolivia Hill, Curry's Gap, Gibraltar and Mt McKenzie). Report to the NSW National Parks and Wildlife Service, J.A. Hunter Pty Ltd, Invergowrie, NSW.
- Keith, D.A. (2004) *Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT*. (Department of Environment and Conservation (NSW): Hurstville).
- Leigh, J., Boden, R. & Briggs, J. (1984) *Extinct and endangered plants of Australia*. (Macmillan: South Melbourne).
- McDonald, W.J.F. (1996) Spatial and temporal patterns in the dry seasonal subtropical rainforests of eastern Australia, with particular reference to the vine thickets of central and southern Queensland. Unpub. PhD Thesis. (University of New England, Armidale).
- Namoi Valley Independent (2005) Drought bites the dust. p.6 *Namoi Valley Independent*, Thursday 6th January 2005. (Gunnedah Publishing Company, Gunnedah).
- NSW Department of Mineral Resources (1996) *Gunnedah Coalfield (South) Regional Geology 1: 100 000 Map Sheet*. (NSW Department of Mineral Resources, Sydney).
- NSW Department of Mines (1971a) *Tamworth 1: 250 000 Geological series sheet SH 56–13*. (NSW Department of Mines, Sydney).
- NSW Department of Mines (1971b) *Inverell 1: 250 000 Geological series sheet SH 56–5*. (NSW Department of Mines, Sydney).
- Sattler P. & Williams R. (1999) *The conservation status of Queensland's bioregional ecosystems*. (Queensland Government Environmental Protection Agency: Brisbane).